TECH. MEMO MAT/STR 1136

UNLIMITED

AD112066

TECH. MEMO MAT/STR 1136

ROYAL AEROSPACE ESTABLISHMENT

ACOUSTIC QUALIFICATION OF AN ANECHOIC CHAMBER

by

D. J. Hendy

August 1989

Procurement Executive, Ministry of Defence
Farnborough, Hampshire

UNLIMITED

CONDITIONS OF RELEASE

0056311 BR-112066

****************************** U

****************************** Y

Reports quoted are not necessarily available to members of the public or to commercial organisations.

ROYAL AEROSPACE ESTABLISHMENT

Technical Memorandum Mat/Str 1136

Received for printing 10 August 1989

ACOUSTIC QUALIFICATION OF AN ANECHOIC CHAMBER

by

D. J. Hendy

SUMMARY

The aim of the work was to determine the working space and frequency range limits of an anechoic sound chamber for accurate measurements of source sound power and directivity.

This was achieved by following guidelines in British Standard 4196 and noting the decrease of measured sound pressure levels with increasing distance from the source.

Results indicated that the chamber tested in this work was suitable for measurements within 1.5 dB across a frequency range of 125 Hz to 20 kHz so long as microphones are placed sufficiently far from the source and chamber walls. The characteristics of certain source sound fields may lead to an increase in the lower limiting frequency however. Keywords: anechoic chambers; laboratory equipment; (AW)

LIST OF CONTENTS

1 INTRODUCTION

A fully anechoic, medium sized chamber has recently been relocated by the Structural Dynamics division of the Royal Aerospace Establishment. As part of the process of proving the facility, the working space and frequency range limits of the chamber have been determined by means of measuring radiated sound pressure levels following guidelines in British Standard 4196 [1]. This work describes the construction of the facility and presents the calibration procedure and the results obtained. Some reference is also made to measurement guidelines laid down in the British Standard and scientific literature.

2 CHAMBER DESIGN

In any enclosed sound field, there is a free field region in which sound directly radiated from the source is dominant, and beyond this a reverberant field which builds up by the continual reflection of sound off reflecting surfaces. An anechoic chamber is designed to simulate a free field environment. In order to achieve an extensive free field environment, the walls of the chamber have to be highly absorbent and to have high transmission losses to provide a quiet environment. The size of the chamber should also be large enough to accommodate the sound source and its sound field.

With regards to the chamber to be calibrated, the interior surfaces of the walls are lined with 0.3 m long acoustic foam wedges, arranged with their adjacent dihedrals mutually at right angles. The interior space of the chamber is 3.6 by 4.8 by 4.1 m from wedge tip to wedge tip. The side walls of the chamber are 0.52 m thick, and are constructed out of blockboard, a wooden framework, hardboard and acoustic foam lining. The whole facility is housed inside a much larger, brick walled, steel roofed, outer building. The dimensions of the chamber are shown in Fig 1. The dimensions of a wedge and the wall sections are shown in Figs 2 and 3 respectively.

With regards to ancillary facilities, a hole close to the side of the door provides access for electrical cables and access space through the doorway measures 1.94 by 0.77 m. Wooden floor beams of 9.0 by 4.5 cm section and five holes in the roof, provide points at which suspension cables can be anchored. Lighting is provided by four, 150W, bulbs at the four corners in the roof.

3 MEASUREMENT PROCEDURE

3.1 Basic technique

If a sound chamber is anechoic and no sound is reflected off its walls, the intensity of the sound remote from the source should decrease with distance from the source according to the inverse square law. The region in which this inverse square law is obeyed lies in the free field, and it is in this region where the sound power and directivity of the sound source can be conveniently determined by measuring sound pressure. In this work, working space limits of the chamber were established by means of plotting measured sound pressure levels against distance, and highlighting positions at which differences between measured levels and levels predicted from the inverse square law exceeded tolerances defined in BS 4196 [1].

In calibrating the chamber and analysing the results, guidelines laid down in Annex A, 'Test room qualification procedures', in BS 4196, Part 5 [1] were closely followed. One guideline not followed however, stipulated that the microphone should be continuously moved away from the source. In the tests carried out in this work, the microphone was moved away in discrete steps. An argument for the British Standard guideline is that at high frequency, maxima and minima of sound pressure due to the excitation of acoustic room modes, can be very tightly packed. To ensure reliable checking, the spacing between measurement points would have to be impracticably small, and hence continuous measurement is recommended. However, subsequent analysis of the results indicated that for this chamber, the influence of room modes rapidly decreases with frequency, and the spacing between the discrete measurement points is such as to define accurately the maxima and minima present at the low frequencies. Hence the fact that pressures were measured at discrete points should be of no consequence.

3.2 Test source characteristics

At sufficiently large distances from any finite source region radiating into a free field, the fluctuating pressure and velocity of a radiated sound wave are simply related as in a plane wave travelling away from the source. As the source is approached from any given direction, departures from the plane wave relationship are generally observed, and sound pressures no longer obey the inverse square law. This region, close to the source, is known as the source near field. In order to be able to distinguish between the influence of source and chamber characteristics, the near field surrounding the source must not encroach on the reverberant field close to the chamber walls. Hence it is desirable for the test source to have a small near field. Since the size of the source near field generally increases with source size, the test source should be as small as possible.

A small source not only has a small near field but also tends to radiate sound equally strongly in all directions. As frequency increases and acoustic wavelength decreases, the acoustic wavelength approaches the size of the source, and the source may radiate sound much more strongly in some directions than in others. Directional sources are undesirable because measured results would not properly account for reflections off all the walls, and measured sound pressure levels would be sensitive to any slight deviation the microphone path took from a straight, radial line.

Unfortunately very small sound sources are not very efficient radiators of sound, particularly at low frequencies where background sound levels can be relatively high. In order to generate sufficiently high sound pressure levels at all frequencies of interest, the chamber in this work was calibrated using a number of different sources. Extensive measurements were carried out using the High Frequency Unit of the B&K Isotropic Sound Source, Type 4241. This source comprises 12, ½ inch dome speakers driven in phase and arranged in the faces of a dodecahedron of effective diameter 20 cm. The source radiated sufficiently high levels of sound down to 100 Hz when driven by pink noise. In order to adequately cover frequencies up to 20 kHz, measurements were also carried out using a single, 1 inch dome Goodmans Axent 100 High Frequency Loudspeaker and a B&K Reference Sound Source, Type 4204. The latter generates sound aerodynamically, and had a fixed broadband sound power output.

Prior to calibrating the chamber, brief tests were carried out in the chamber to measure the directivity of the sources when driven by a pure tone at discrete frequencies ranging from 500 Hz to 10 kHz. The sources were mounted on a B&K Turntable, Type 3921, and sound level output was recorded on polar plots using a B&K Level Recorder, Type 2305. The results indicated that if the microphone path was to deviate from a straight line during a radial traverse, sound pressure level variations due to source directionality effects would be most pronounced when using the B&K Isotropic Sound Source. For example, at 5 kHz, rotating the 1 inch dome speaker through 5 degrees about its principal axis, (which is equivalent to a maximum deviation of 8.7 cm of the microphone along a 1 m long path) resulted in less than a 0.5 dB variation in sound pressure level. For the Isotropic Sound Source, sound pressure levels varied by as much as 5 dB through 5 degrees at 5 kHz. Although the directionality of the B&K Reference Sound Source was not measured, measured data published by B&K[2] indicate that over the ⅓ octave band centred on 6.3 kHz, radiated sound pressure levels for a 5 degree rotation ould vary by less than 1 dB. Polar plots recorded at 5 kHz using the B&K Isotropic Sound Source and the 1 inch dome speaker, are shown in Figs 4 and 5 respectively.

3.3 Source mounting

The B&K Isotropic and Reference Sound Sources were mounted on a 1.8 m long, 5 cm diameter, steel pole anchored to the floor. Three inch thick, acoustic foam matting was wrapped around the pole along its complete length to reduce the effect of sound reflections off the pole.

The 1 inch dome speaker was suspended from four directions using 26 SWG guage, stainless steel, piano wire.

3.4 Microphone suspension

In order to be able to measure sound pressure levels which decrease in accordance with the inverse square law of distance from the source, the microphone has to be situated in a free field environment and follow a straight path from the source to avoid source directionality effects. Hence, reflections from any microphone support structure must be minimal, and the measurement points must lie on a straight line. To achieve these two conditions, the microphone was clipped to a piano wire extending from the source to an anchor point at the end of the traverse. Attachment of the microphone is shown in Fig 6. In order to isolate the microphone preamplifier electrically from the wire, several layers of masking tape were wrapped around the preamplifier. A turnbuckle at the anchor point was used to tighten the wire until no deviation of the wire from a straight line could be detected when viewed at eye level from one end. Such a procedure was thought to reduce any source directionality effects on sound pressure level to less than 1 dB. This check was repeated after completing the microphone traverse. Brief tests revealed that measured sound pressure levels, with and without the 26 SWG gauge wire in place, across ⅓ octave bands between 100 Hz and 20 kHz, changed levels by less than 0.3 dB.

Such a method of suspending the microphone does not suffer from reflection of sound off nearby supporting structure and enables measurements to be made both close to the source and chamber boundaries. Authors who have presented work in previous reports[3-8] on chamber calibration have used bulkier supporting structure and make no reference to the vicinity of the chamber boundaries when they state deviations from the inverse square law.

3.5 Microphone traverses

The microphone was traversed along eight paths from the Isotropic Sound Source, placed 0.4 m from the centre of the chamber, to an anchor point placed close to each corner of the chamber. Sound pressure levels were measured at 16 points on each path. These points were spaced so as to give equally spaced points when plotted on a logarithmic scale of the distance from the geometric centre of the source. Distances from the speaker grill were measured using a tape measure for paths extending to the bottom four corners of the chamber. Distances of points on the four paths extending to the root were determined by measuring the phases between a 1 kHz pure tone signal going into the speaker and the signal monitored at the microphone. Distances from the speaker grill were calculated from the acoustic wavelength, λ, the phase angle, ϕ, and the distance of a reference point behind the speaker grill, d_c, according to the formula,

$$d_m = \left(\frac{n + \phi}{360}\right) \lambda - d_c$$

where n = whole number of acoustic wavelengths.

The distance of the reference point behind the speaker compensated for the phase delay introduced by the delay in the speaker reacting to its input signal, and as shown in the above formula, had to be known in order to define the distance from the source. The location of the reference point was estimated by measuring with a tape measure the distance of the microphone from the source, when traversed along a path extending to one of the chamber's bottom corners, and subtracting these distances from distances calculated from the acoustic wavelength and phase angle alone. For each of the 16 points measured along this path, estimates of the distance of the reference point behind the speaker grill, ranged from 3.8 cm to 6.6 cm and averaged 5.2 cm. Such a range in values yielded predicted distances of microphone from source and subsequent sound pressure levels which differed by less than 0.2 dB from levels which assumed a reference point 5.2 cm behind the speaker grill. In subsequent analysis of the results obtained using this sound source, a reference point at a distance of 5.2 cm was assumed.

In moving the microphone along the paths extending to the bottom of the chamber, the microphone was simply slid along the wire by hand. In order to move the microphone along paths extending to the roof, a string was taped to the microphone. The string was run to a fixing at the anchor point in the roof and dropped to the floor. Pulling on the string then pulled the microphone along the wire. By means of monitoring the phase read out on a digital Kemo, Type DP1, phase meter, the required distance from the source was obtained.

Figs 7 and 8 show the eight microphone paths extending from the B&K Isotropic Sound Source. In measuring sound pressure levels using the 1 inch dome speaker and the B&K Reference Sound Source, only one path was used. These are shown in Figs 9 and 10 respectively.

3.6 Equipment used

The speaker sources were driven by pink noise generated by a B&K Sine Random Generator, Type 1027. Sound pressure was measured by a ½ inch, free field, B&K Condenser Microphone, Type 4133, and analysed by a B&K Digital Frequency Analyser, Type 2131, to yield ⅓ octave spectra. In order to reduce random errors to a minimum, an averaging time setting of 128 seconds was used. Measurements using the Isotropic Sound Source could then be repeated across any band to within 0.3 dB. A schematic diagram of the source and receiving equipment is shown in Fig 11.

4 DATA ANALYSIS

4.1 Compensation for background sound pressure levels

Background levels were found to be less than 34 dB acros any ⅓ octave band in the frequency range 100 Hz to 20 kHz and were a maximum at 100 Hz. Background levels measured at the beginning and end of each mcrophone traverse were found to be at least 11 dB less than levels measured at the end of each traverse with the source on. An 11 dB difference adds 0.3 dB to measured levels. No compensation for background noise was made. A bar chart of typical measured background levels is shown in Fig 12.

4.2 Compensation for variation in ambient temperature

One of the influences of temperature variation in the atmosphere is to alter the speed of sound and hence acoustic wavelength at a given frequency. Temperature in the chamber was found to vary from 20°C to 29°C throughout the test period, and could vary by as much as 4°C during a microphone traverse. Such rapid temperature variations were thought to be largely due to heating from the chamber lights. In calculating distance between microphone and source, acoustic wavelength was calculated as a function of measured temperature.

4.3 Compensation for atmospheric attenuation

In any enclosed space, sound energy is not only absorbed at the boundaries, but also in the air itself due to viscosity. Sound pressure levels in the chamber were measured up to distances of 3 m from the source. Over this distance, sound pressure levels have been calculated to be attenuated by about 2 dB at 20 kHz, and 0.5 dB and 0.3 dB at 10 kHz and 6 kHz respectively. These values were calculated from curves of measured data presented by Kinsler and Frey[9], and correspond to a relative humidity of 37% and a temperature of 27°C. Humidity was not measured in this work and the results were not compensated for atmospheric attenuation.

5 DISCUSSION OF RESULTS

5.1 Presentation of predicted and measured sound pressure levels

Sound pressure levels (re 2.0E-5 N/m^2) have been presented within each ⅓ octave band across a 100 Hz to 20 kHz frequency range.

Sound pressure levels at various distances from a sound source, which obey the inverse square law, will lie on a straight line of slope equal to -20 dB/log r unit when plotted against distance from the source on a log scale. In order to compare the rate of decay of levels which obey the inverse square law, and the rate of decay of measured levels, straight lines of slope -20 dB/log r unit were drawn through a point on the measured curve which lay on the straightest portion of the curve.

In order to distinguish easily between measured sound pressure levels which correspond to the different frequency bands, measured sound pressure levels were offset to give a 5 dB spacing between the predicted lines.

5.2 Overall trends

Fig 13 shows measured sound pressure levels plotted against distance from the source for the eight microphone traverses extending from the Isotropic Sound Source. Measurement points at which deviation of sound pressure level from the ideal straight line exceeds the British Standard tolerance (*ie* ±1.0 dB in the frequency range 800 Hz to 5 kHz and ±1.5 dB outside this range) are largely restricted to levels measured above 1.6 kHz and below 400 Hz. Above 1.6 kHz, measurements are influenced by the near field at the source out to distances of about 1 m from the source. Below 400 Hz, measurements are influenced by the reverberant field close to the chamber wall, which starts to influence measurements at points further than 0.5 m from the source. Between 400 Hz and 1.6 kHz, measured levels at points on all eight traverses decay in strict accordance with the inverse square law.

5.3 Near field and reverberant field criteria

Fig 14 shows the results presented in Fig 13 but includes curves representing a near field criterion at the source and a reverberant field criterion at the chamber wall. These criteria are cited in BS 4196. The criterion, $r = 2D$, bounds points which lie a distance $2D$ from the source, where D is the largest source dimension. The criterion, $s = \lambda/4$ bounds points which lie less than $\lambda/4$ from the wedge tips at the chamber walls where λ is the acoustic wavelength at the centre frequency of the measurement band. The results obtained in this work imply that both the near field effects at the source, and the reverberant field effects at the chamber walls, significantly exceed the bounds given by these guidelines.

Fig 15 again shows the measured sound pressure levels plotted against distance from the source, but includes optimum criteria for the source and chamber tested in this work. The reverberant field at the chamber walls evidently extends out to half an acoustic wavelength. It should be noted however that the distribution of the reverberant field at the chamber walls is influenced by the location of the source in the chamber[10]. The source was positioned 0.4 m from the centre of the 3.6 by 4.8 by 4.1 m chamber so lay close to the chamber centre.

Background relating to the critorion shown in Fig 15 bounding the near field at the source has been presented by Malecki[11], Junger and Feit[12], and Morphey[13].

5.4 Lower frequency limits

Fig 16 shows measured sound pressure levels plotted against distance from the source for frequencies up to 1 kHz. Also indicated on the graphs are three lines representing minimum distances from the source at which points lie 1.5, 1.0 and 0.5 m from wedge tips at a chamber wall. Evidently the minimum frequency at which levels lie within the British Standard tolerance is 125 Hz for points 1.5 m or more from the wall, 400 Hz for points 1.0 m or more from the wall, and 500 Hz for points 0 5 m or more from the wall.

It should be noted however that a guideline commonly quoted in the scientific literature states that a microphone should not lie within an acoustic wavelength of the source. Although this guideline is not applicable to the Isotropic Sound Source tested in this work, it is applicable to certain types of source. The physics on which this guideline is based is described by Peterson and Gross[14]. In satisfying this requirement and minimum distances from the chamber walls, for sources placed centrally in the 3.6 by 4.8 by 4.1 m chamber, measurements to within 1.5 dB are only possible at frequencies above 500 Hz.

5.5 Higher frequency limits

Figs 17 and 18 show sound pressure levels plotted against distance from the source measured using the 1 inch dome speaker and the Reference Sound Source respectively. Measurements relating to the 1 inch dome speaker were for frequencies above 400 Hz because of the speaker's inefficiency at low frequencies. High levels of measured sound pressure level close to the Aerodynamic Reference Sound Source, at frequencies less than 1 kHz, were found to be due to flow noise over the microphone. This was detected by covering the microphone with a B&K Foam Windscreen and noting reductions in measured levels. Most significantly however, both sets of results indicate that sound level measurements, to within 1.5 dB, can be made in the chamber up to 20 kHz.

6 CONCLUDING REMARKS

Zones over which microphones may be placed in an anechoic sound chamber for the accurate measurement of source sound power and directivity have been clearly highlighted by means of noting how measured sound pressure levels decrease with increasing distance from a sound source.

Results indicate that measurements maybe made to within 1.5 dB at frequencies down to 125 Hz, so long as microphones are not placed within 1.5 m of any chamber wall. Measurements to within this accuracy can be made down to a frequency of 400 Hz, so long as microphones are not placed within 1 m of any wall, and down to a frequency of 500 Hz, so long as microphones do not lie closer than 0.5 m to a wall.

In addition to placing microphones a certain distance away from the chamber walls, areas close to the source usually have to be avoided. This will further limit the lower frequency.

With regards to an upper frequency limit, measurements to within 1.5 dB can be made up to 20 kHz.

The results of this work also show that care needs to be taken in interpreting the guidelines in BS 4196. These guidelines are inadequate for placing microphones close to certain types of source and wall lining.

Acknowledgements

The author is grateful to Mr A. Payne for his assistance during the experiments.

REFERENCES

No.	Author	Title, etc
1	British Standards Institution	Sound power levels of noise sources BS 4196. Part 5: Precision methods for determination of sound power levels for sources in anechoic and semi-anechoic rooms. London, British Standards Institution (1981)
2	Bruel Kjaer	Reference Sound Source Type 4204 Instruction Manual. Bruel & Kjaer (1976)
3	L.L. Beranek H.P. Sleeper, Jnr	The design and construction of anechoic sound chambers. *The Journal of the Acoustical Society of America,* 18, No.1 (1946)
4	F. Ingerslev O.J. Pedersen P.K. Moller	New rooms for acoustic measurements at the Danish Technical University. Acustica, 19, No.4 (1967/68)
5	A.J. Ellison B.B. Miller	Design and construction of the anechoic chamber at Queen Mary College. Proceedings of the Institute of Mechanical Engineers, 178, Pt.1, No. 2 (1963/64)
6	D.E.L. Shorter C.L.S. Gilford H.D. Harwood	The acoustic design and performance of a new free-field sound measurement room. BBC Engineering Monograph No.59 (1965)
7	W.J.G. Trebble	The acoustic characteristics of the RAE 1.5 m wind tunnel. RAE Technical Report 79002 (1979)
8	A.N. Rivin	An anechoic chamber for acoustical measurements. Soviet Physics - Acoustics, 7, No.3 (1962)
9	L.E. Kinsler A.R. Frey	Fundamentals of acoustics. John Wiley & Sons, New York (1962)
10	J. Wang B. Cai	Calculation of free-field deviation in an anechoic room. *The Journal of the Acoustical Society of America,* 85(3) (1989)
11	I. Malecki	Physical foundations of technical acoustics. Pergamon Press, Oxford (1969)

REFERENCES (concluded)

No.	Author	Title, etc
12	M.C. Junger D. Feit	Sound, structures and their interaction. MIT Press Cambridge, Massachusetts (1972)
13	C.L. Morphey	Theory of acoustics (II). In Noise and vibration, edited by R.G. White and J.G. Walker Ellis Horwood Ltd, Chichester (1982)
14	A.P.G. Peterson E.E. Gross, Jnr	Handbook of noise measurement. General Radio Company, Massachusetts (1967)

Fig 1

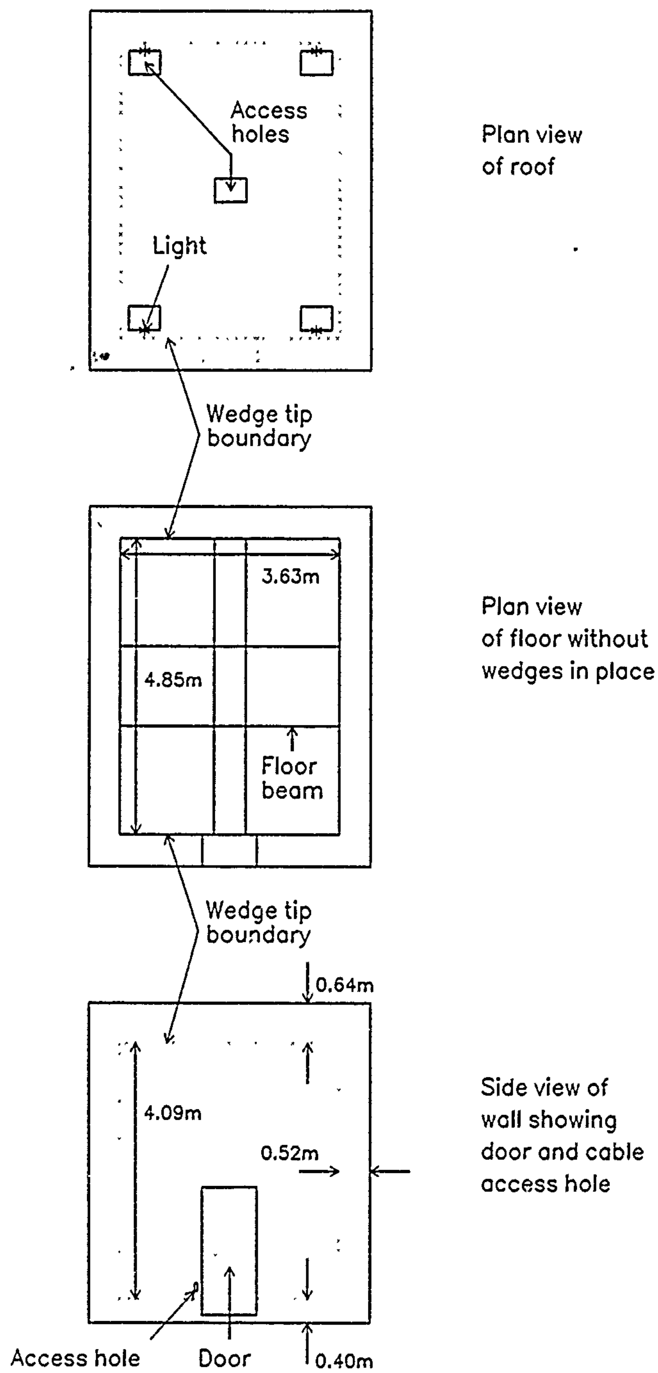
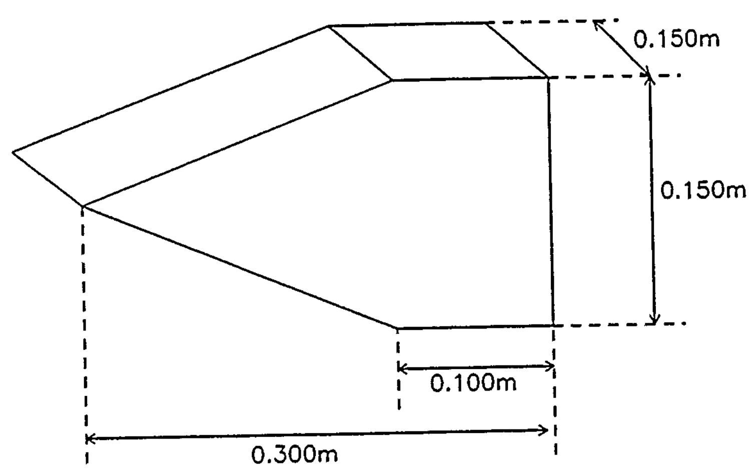


Fig 1 Chamber dimensions

TM M&S 1136



TM M&S 1136

Fig 2 Wedge dimensions

Fig 3

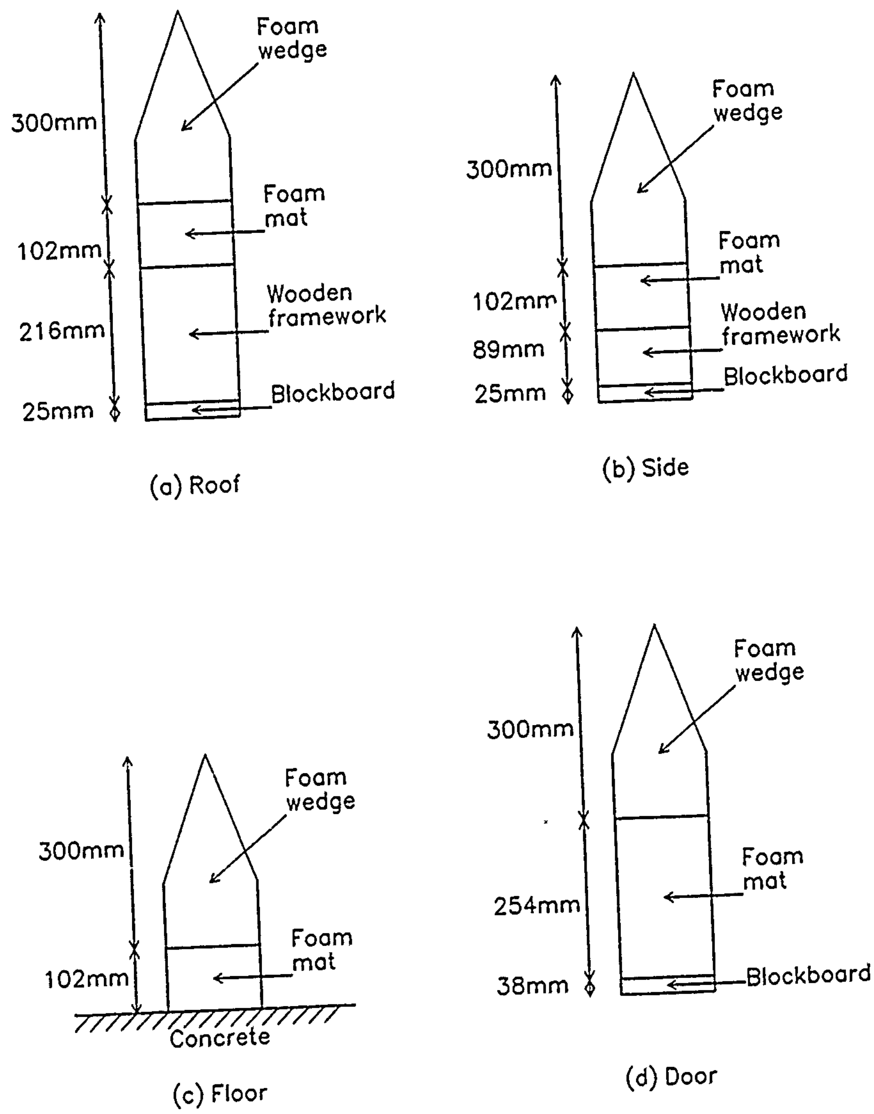
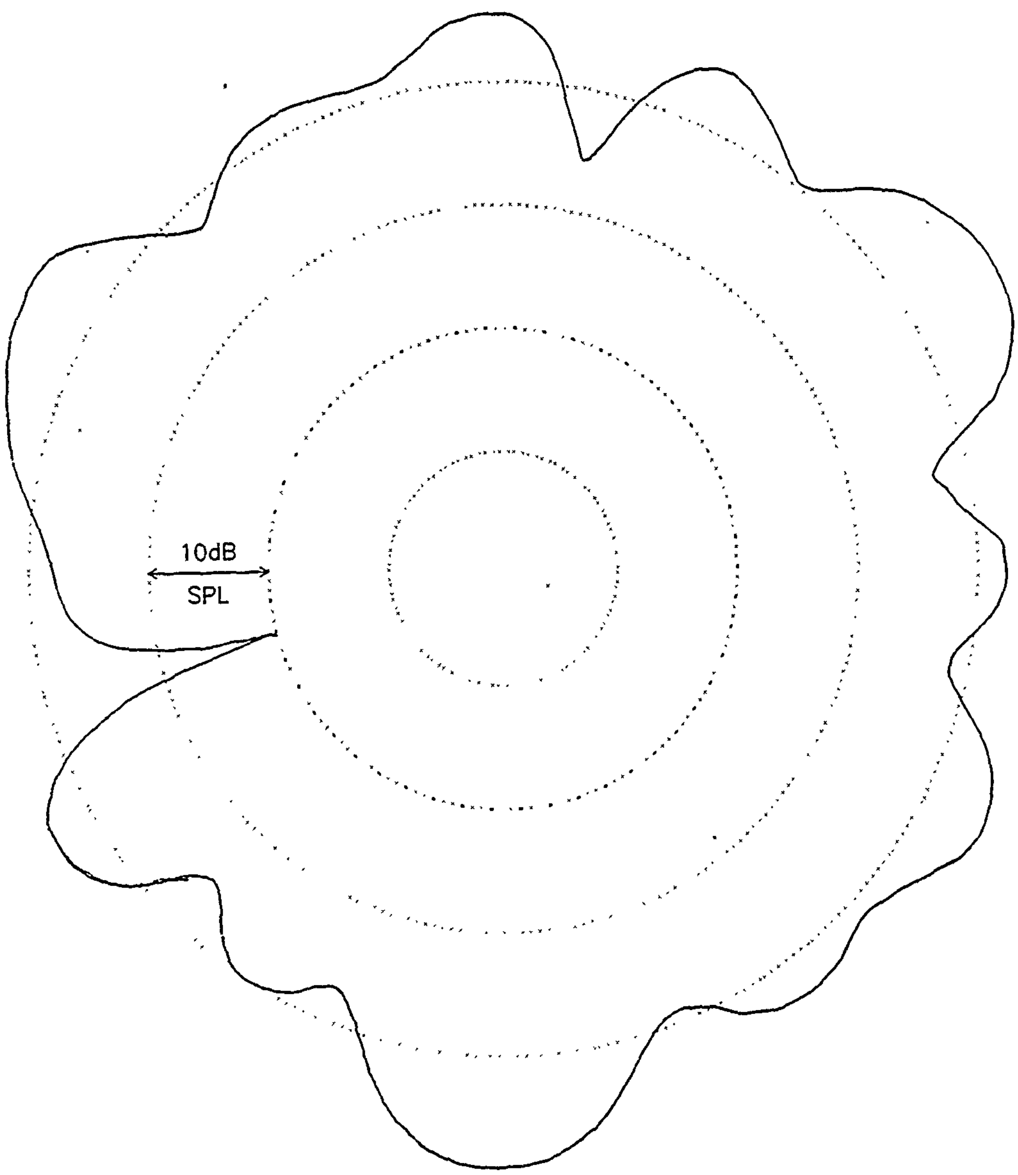


Fig 3 Wall sections

TM M&S 1136

Fig 4



TM M&S 1136

Fig 4 Directional characteristics of the Isotropic Sound Source at 5 kHz

Fig 5

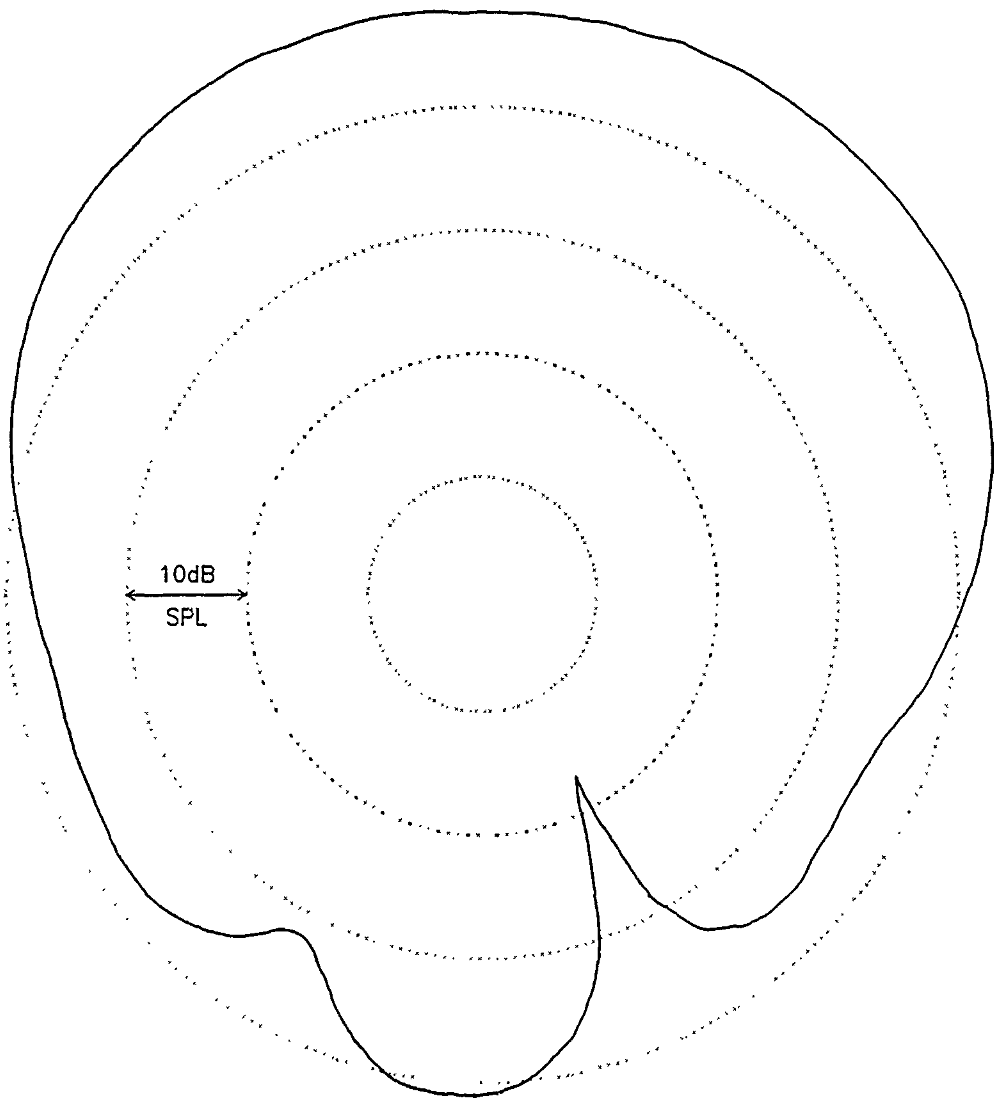


Fig 5 Directional characteristics of the 1 inch dome speaker at 5 kHz

TM M&S 1136

Fig 6

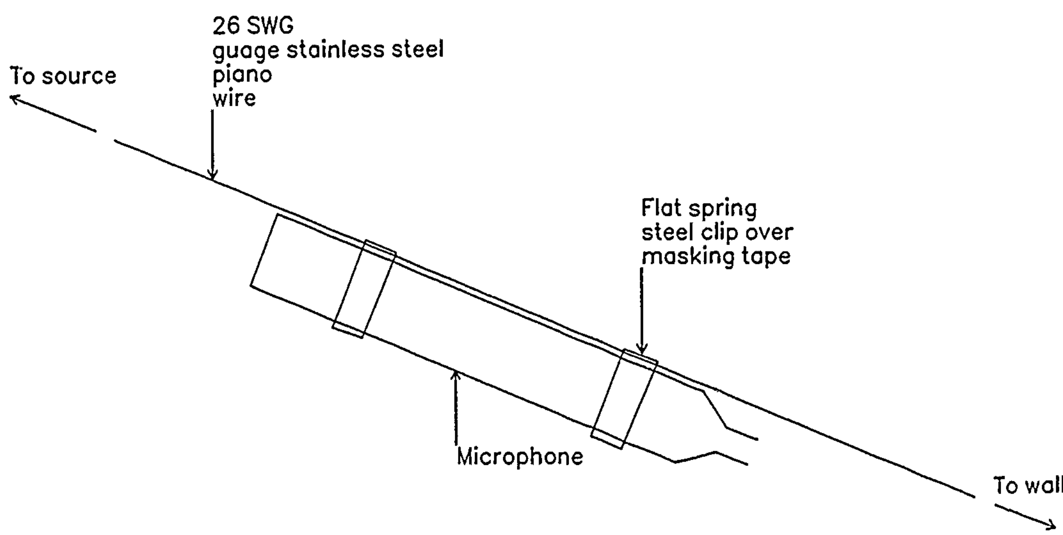
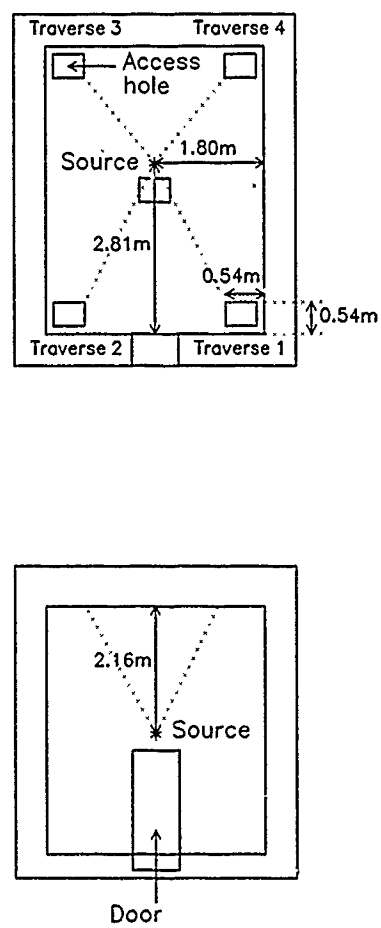


Fig 6 Microphone suspension

TM M&S 1136

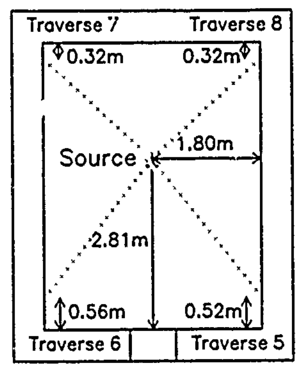
Fig 7



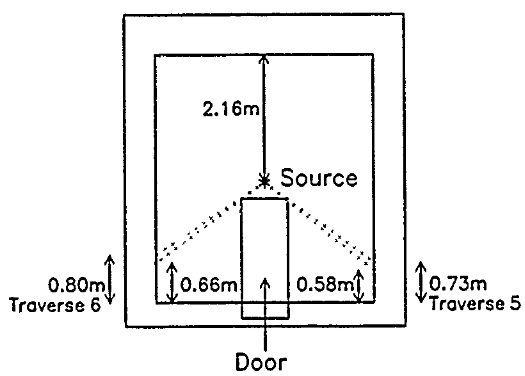
Plan view

Side view

Fig 7 Microphone traverses from Isotropic Source to roof



Plan view



Side view

TM M&S 1136

Fig 8 Microphone traverses from isotropic Source to floor

Fig 9

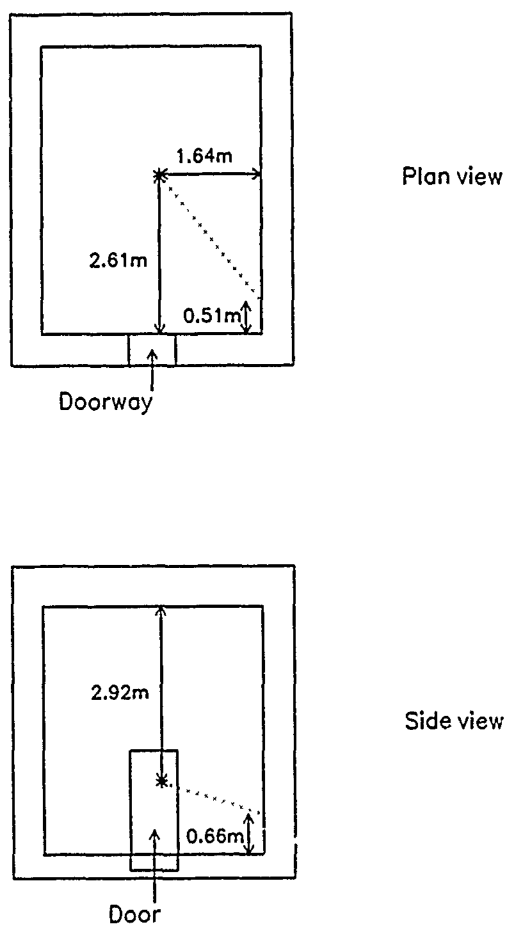
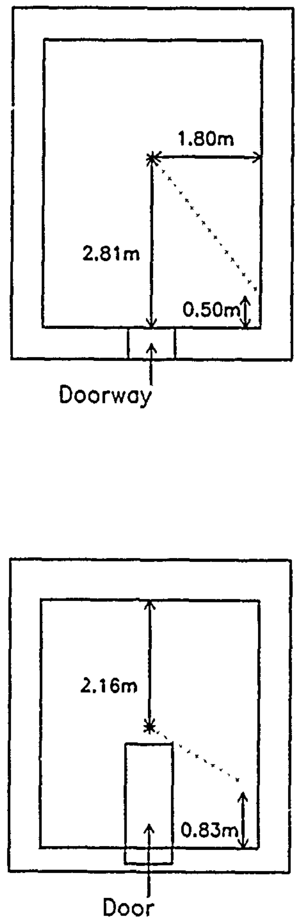


Fig 9 Microphone traverse from 1 inch dome speaker



Plan view

Side view

Fig 10 Microphone traverse from Reference Sound Source

Fig 11

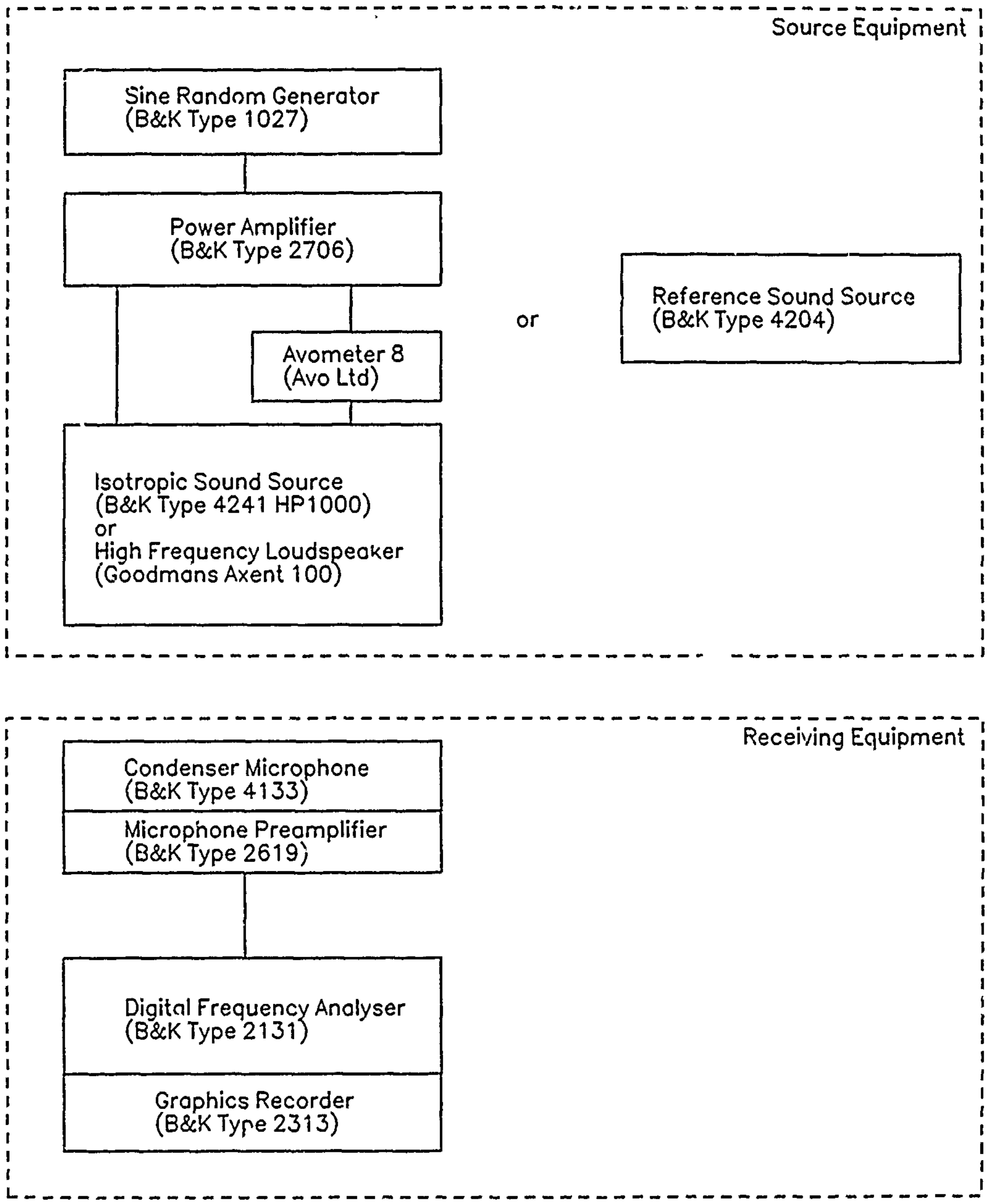


Fig 11 Electrical equipment

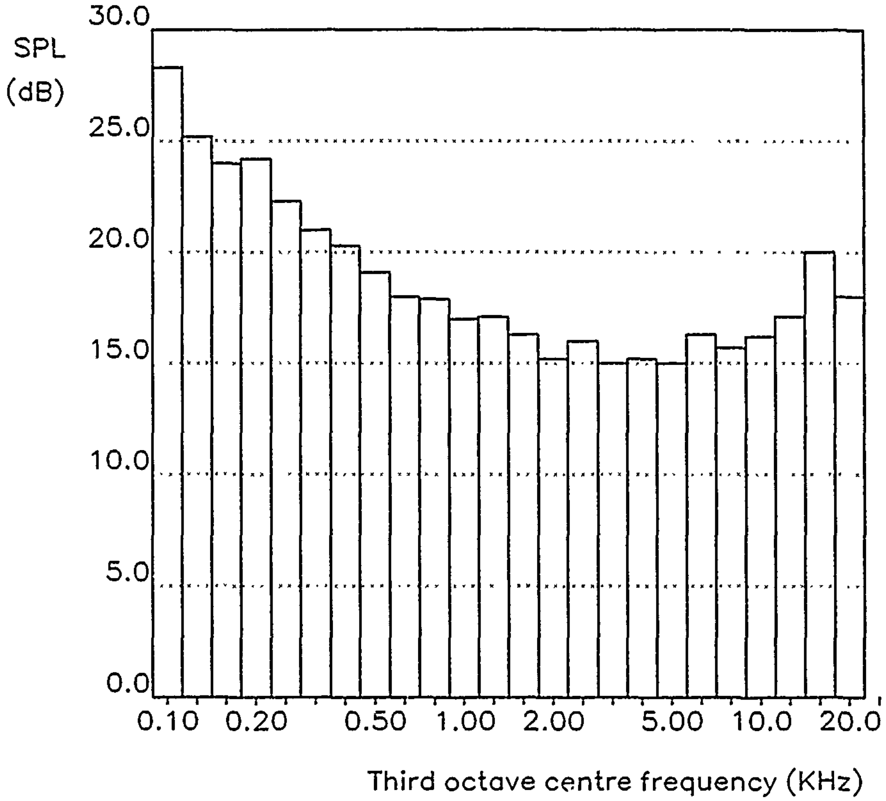


Fig 12 Background noise levels inside the chamnber

Fig 13

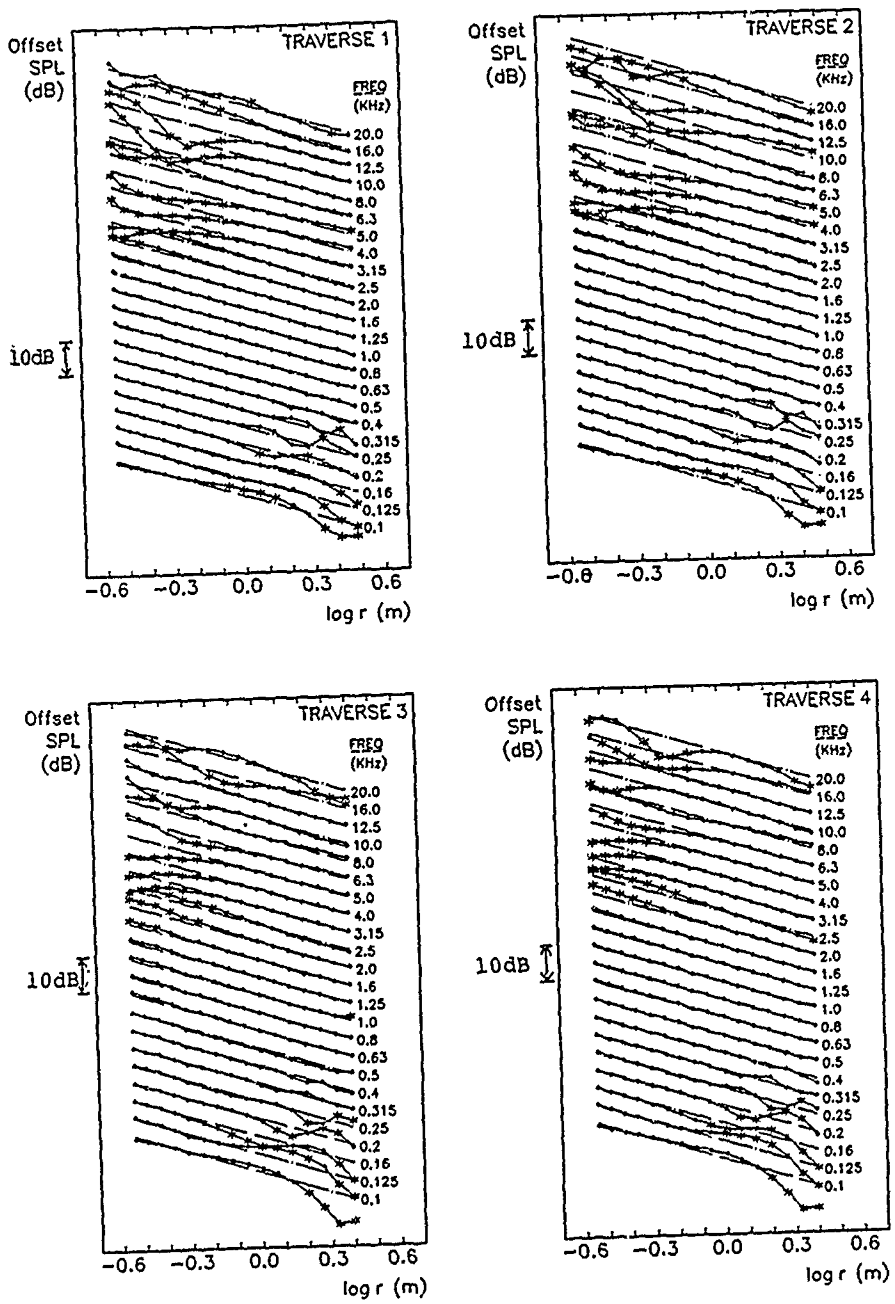


Fig 13 Sound pressure level verses distance from Isotropic Source

—·—·— predicted level

—•—•— measured level (within BS tolerance)

—*—*— measured level (outside BS tolerance)

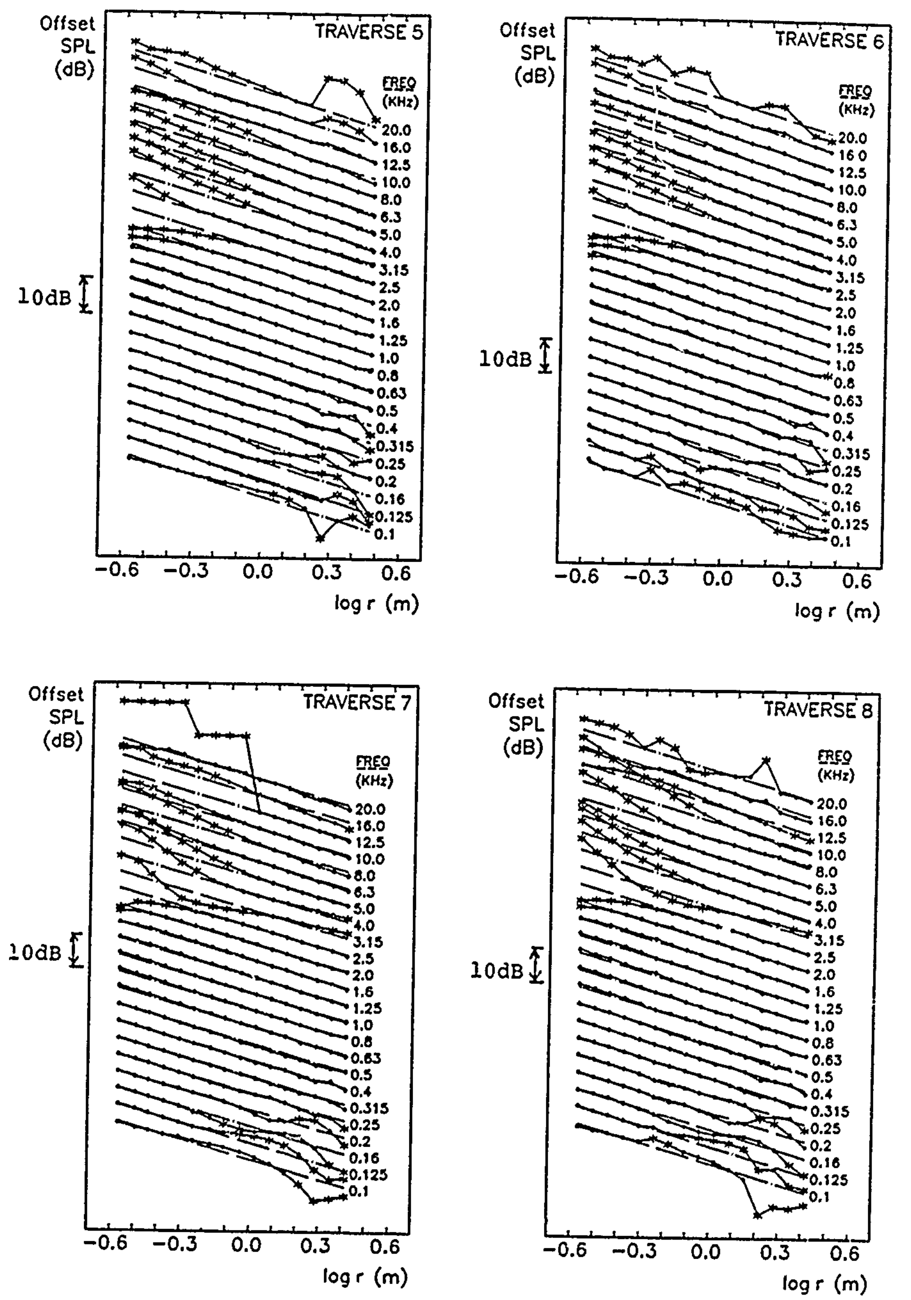


Fig 13 (continued)

Fig 14

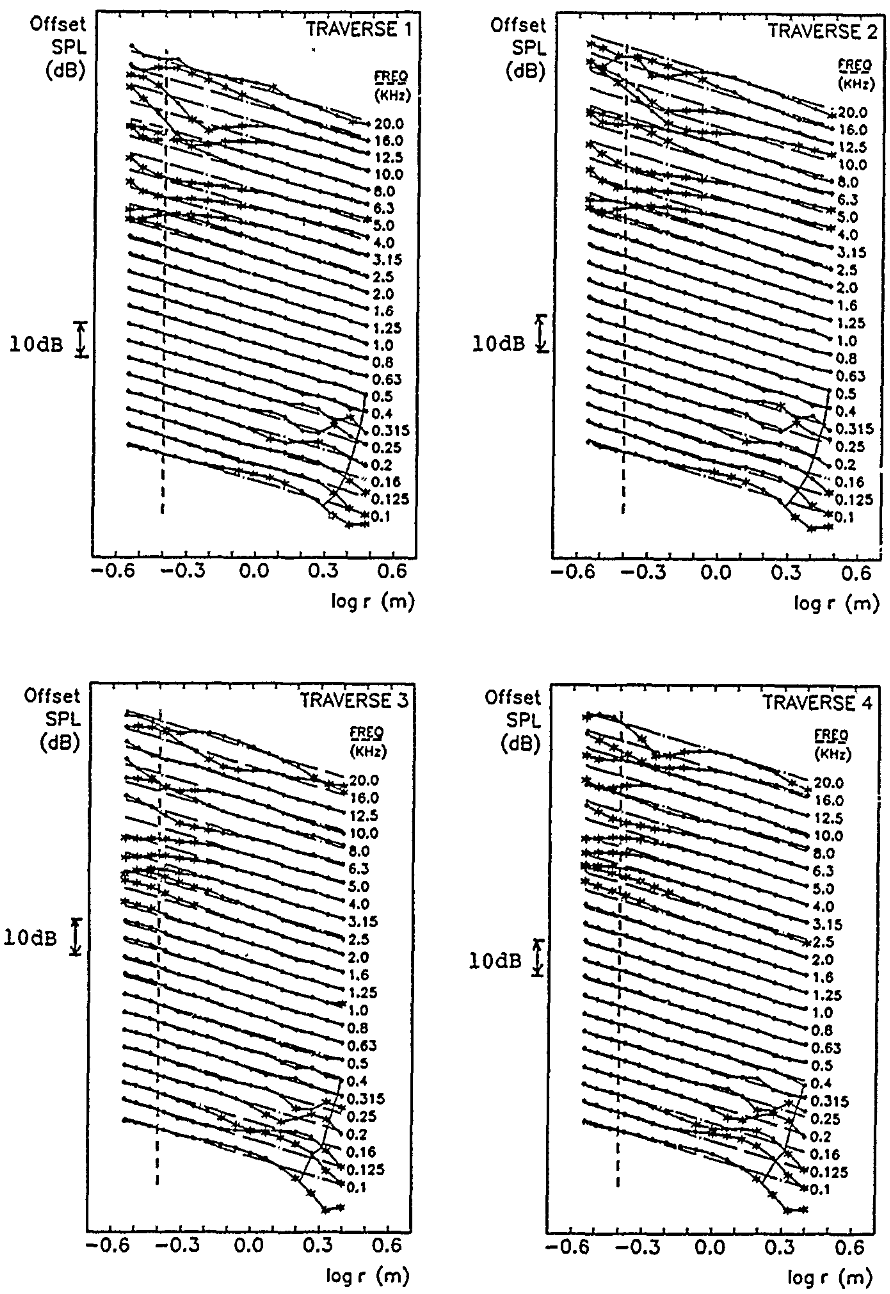


Fig 14 Sound pressure level versus distance from isotropic Source featuring the near field criteria:

$r = 2D$ $\qquad$ $s = \lambda/4$

(see Fig 13 for key to other lines and symbols)

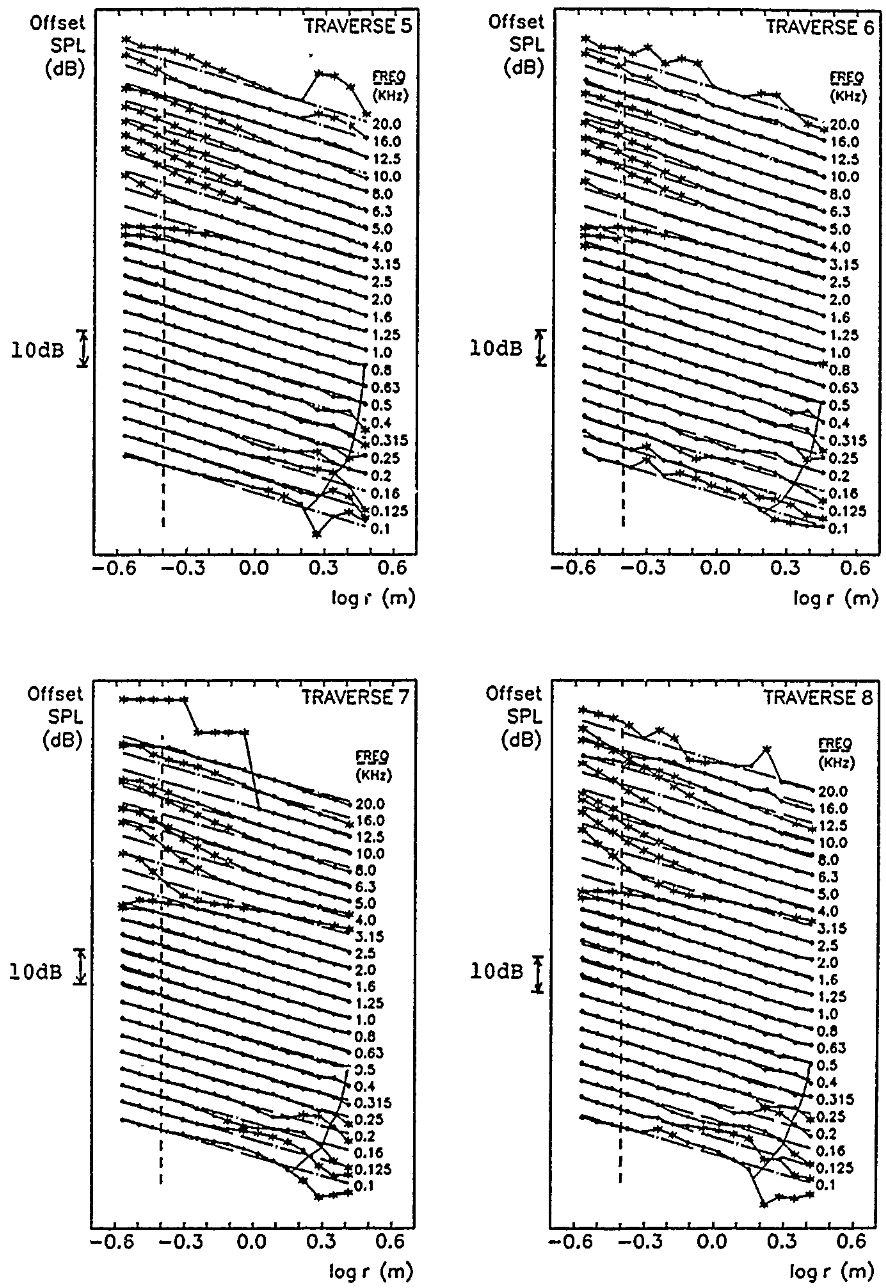


Fig 14 (continued)

Fig 15

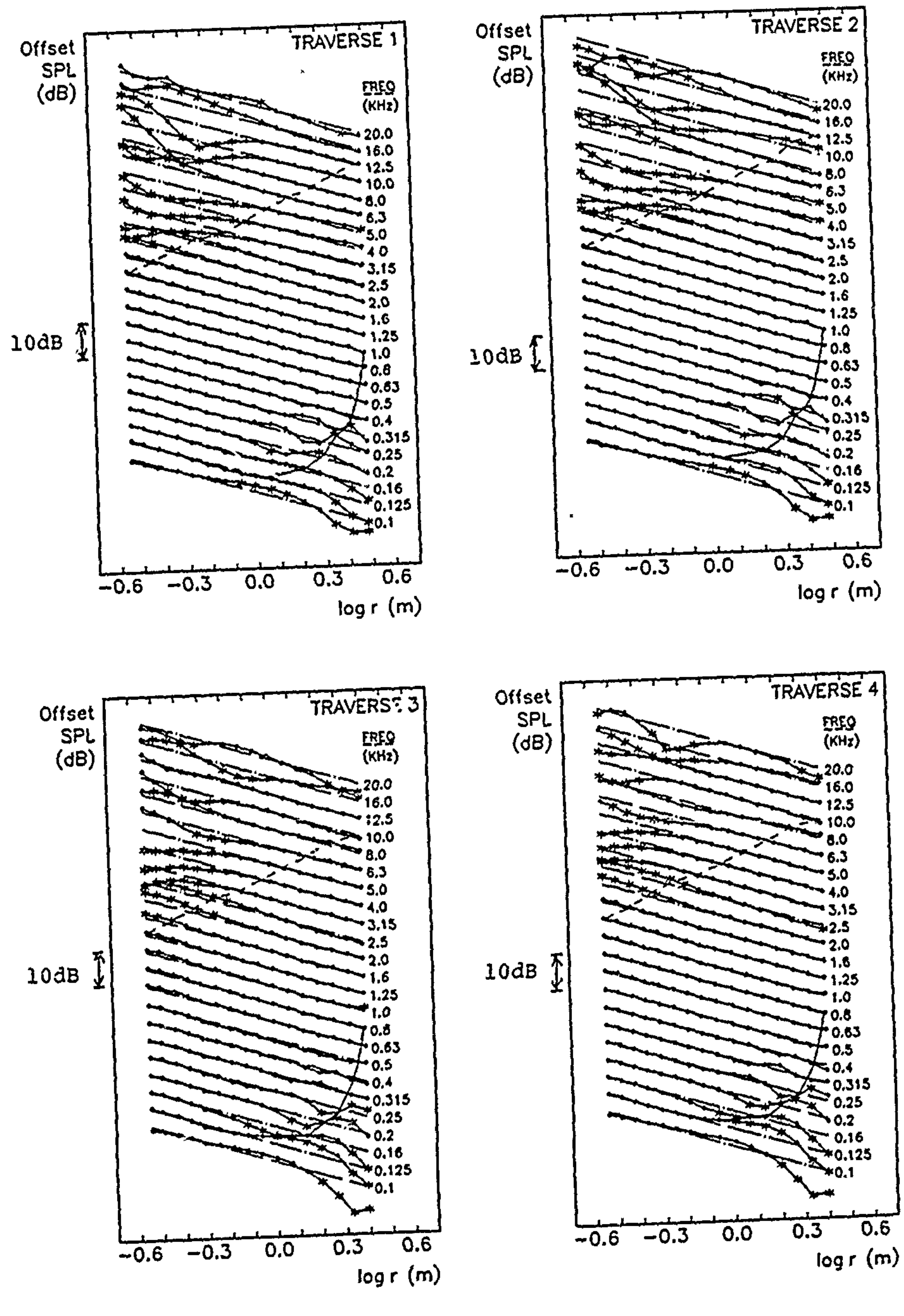


Fig 15 Sound pressure level versus distance from isotropic Source featuring the near field criteria:

$r = 2D^2/\lambda$ $\quad$ $s = \lambda/2$

(see Fig 13 for key to other lines and symbols)

TM M&S 1136

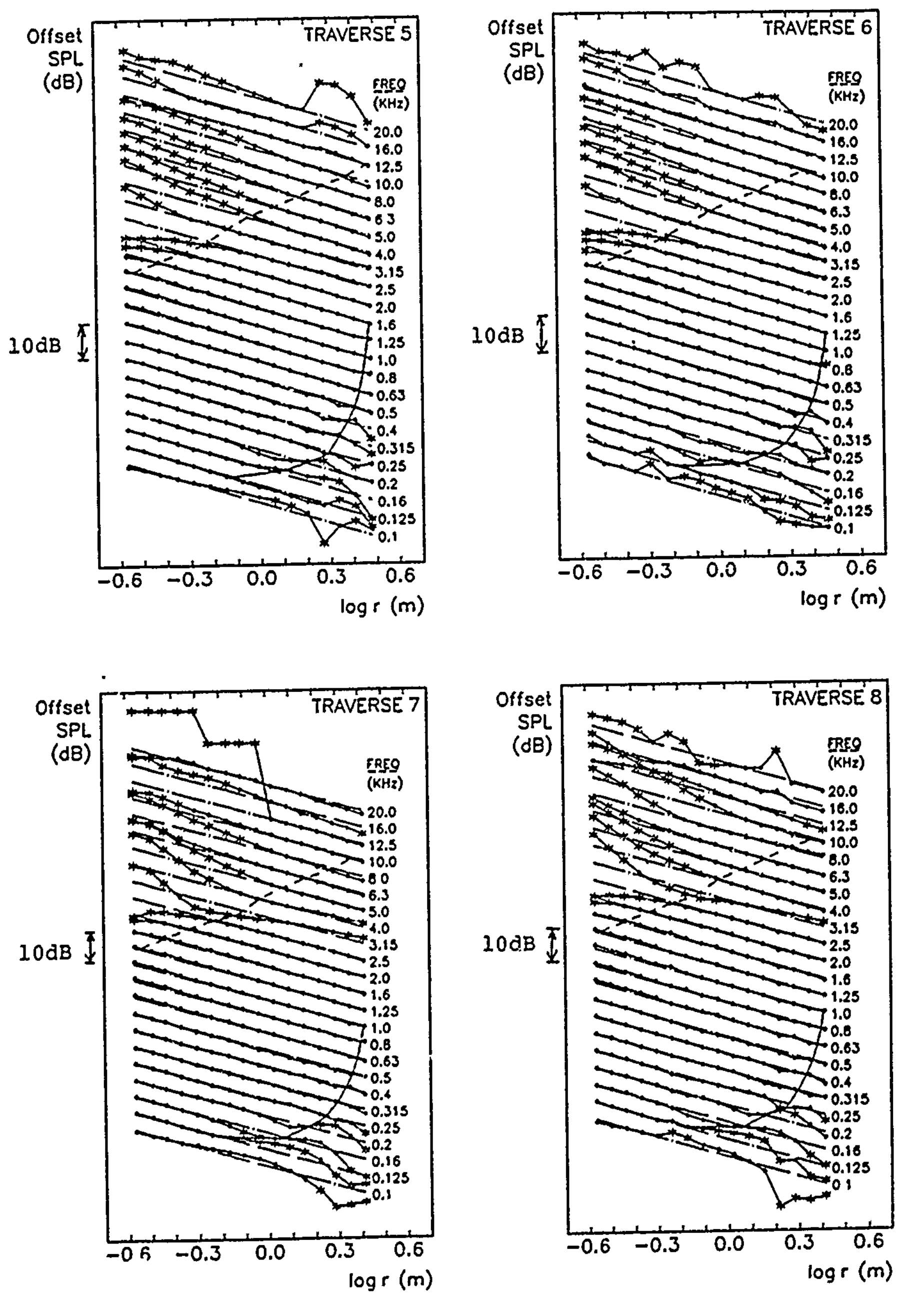


Fig 15 (continued)

Fig 16

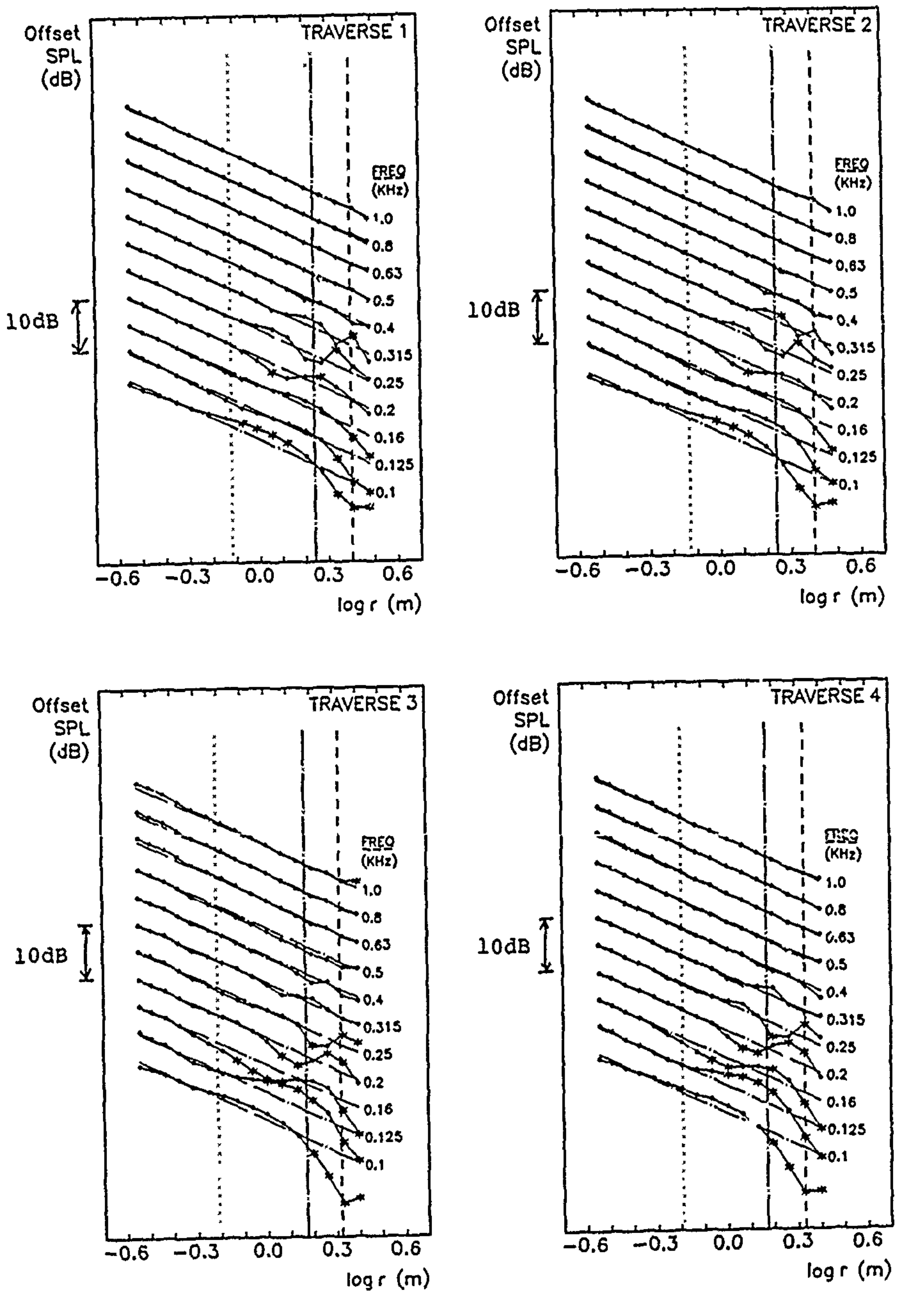


Fig 16 Sound pressure level versus distance from isotropic Source featuring the boundaries:

– – – – s = 0.5 m —–·– s = 1.0 m ······ s = 1.5 m

(see Fig 13 for key to other lines and symbols)

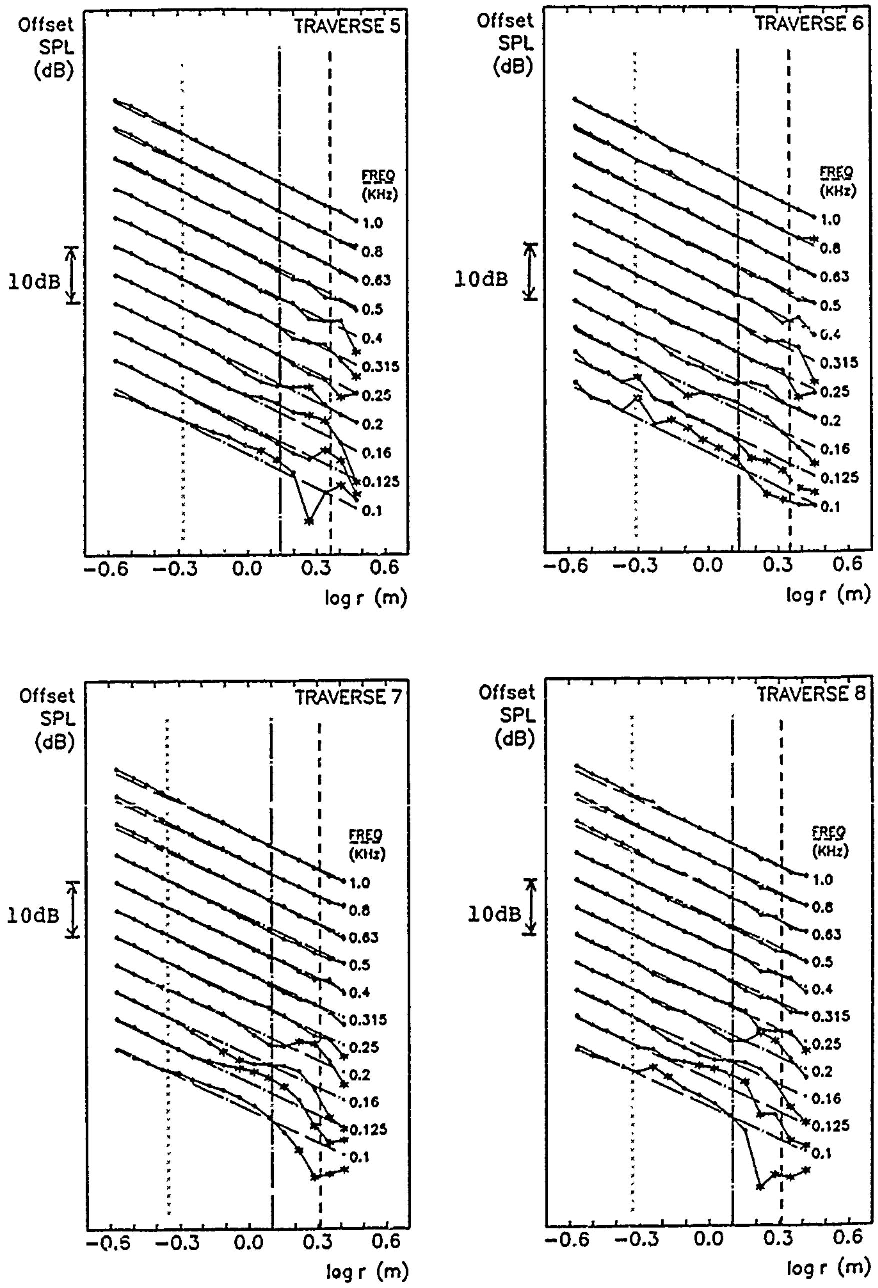


Fig 16 (continued)

Fig 17

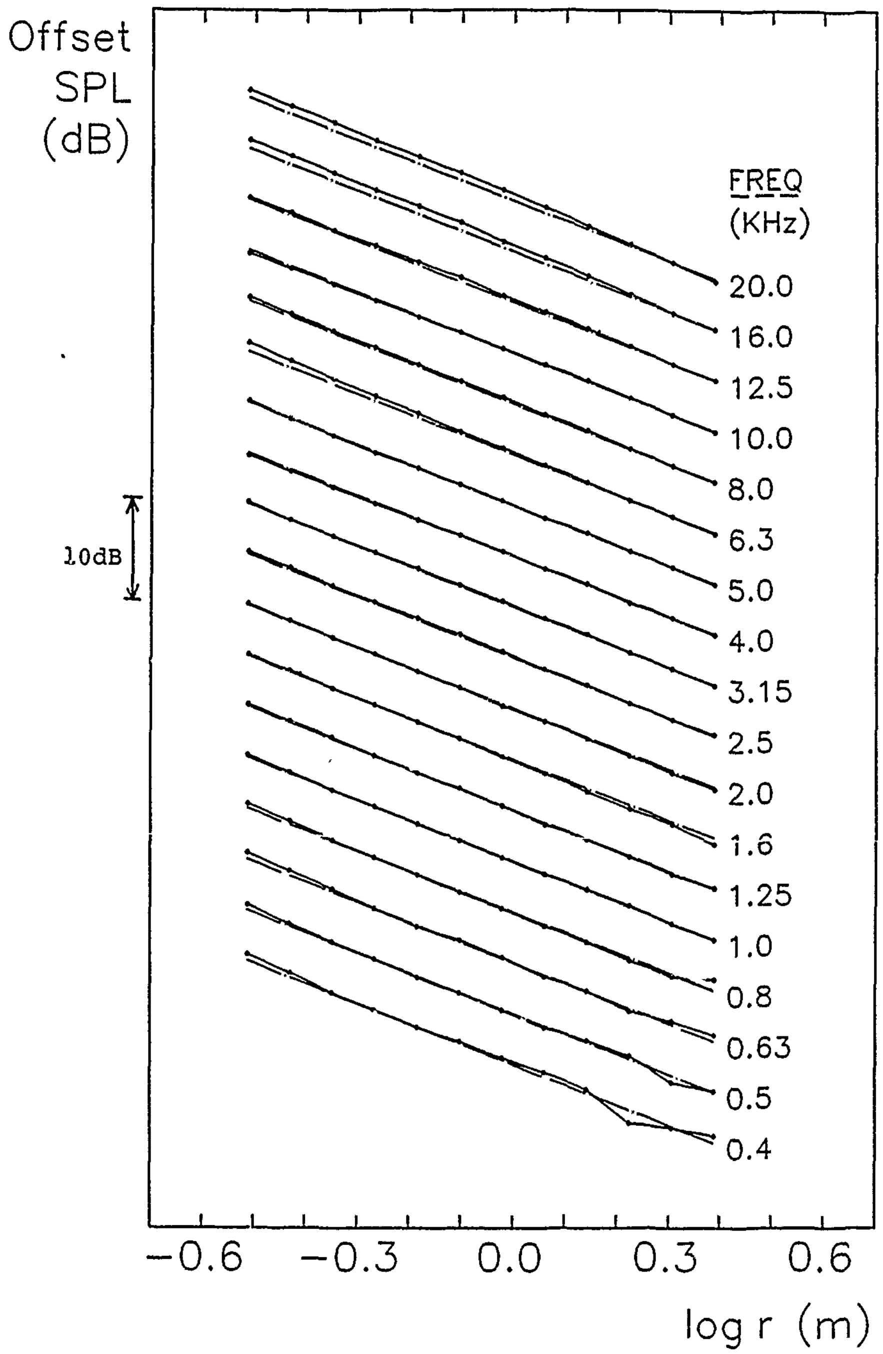


Fig 17 Sound pressure level versus distance from 1 inch dome speaker
—·— predicted —•—•— measured level

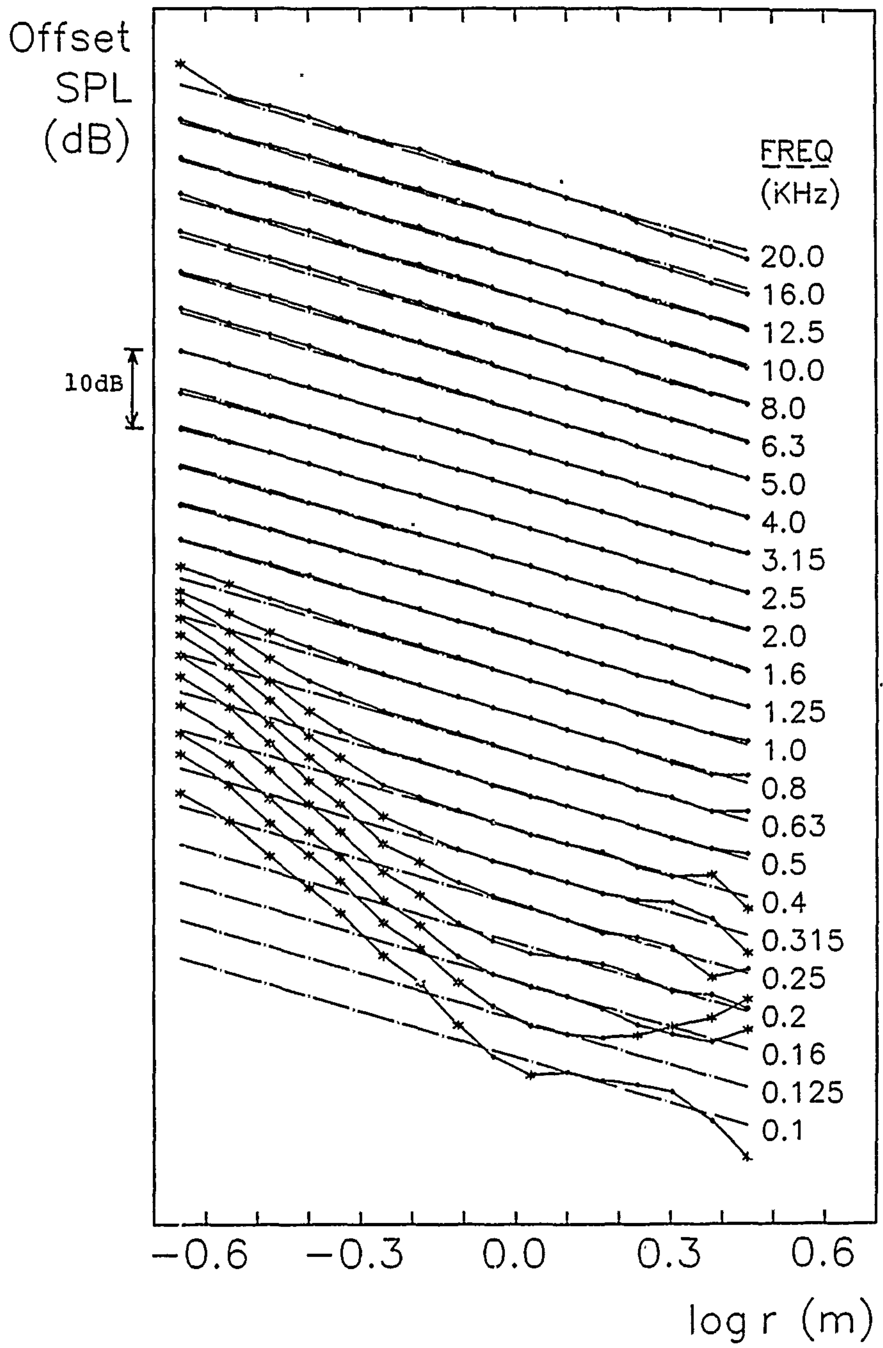


Fig 18 Sound pressure level versus distance from the Reference Sound Source
—·— predicted level
—•—•— measured level (within BS tolerance)
—*—*— measured level (outside BS tolerance)

REPORT DOCUMENTATION PAGE

Overall security classification of this page

Instructions for completion appear overleaf.

UNLIMITED

As far as possible this page should contain only unclassified information. If it is necessary to enter classified information, the box above must be marked to indicate the classification, e.g. Restricted, Confidential or Secret.

1. DRIC Reference (to be added by DRIC)	2. Originator's Reference	3. Agency Reference	4. Report Security Classification/Marking
	RAE TM Mat/Str 1136		UNLIMITED

5. DRIC Code for Originator	6. Originator (Corporate Author) Name and Location
7673000W	Royal Aerospace Establishment, Farnborough, Hants, UK
5a. Sponsoring Agency's Code	6a. Sponsoring Agency (Contract Authority) Name and Location

7. Title Acoustic qualification of an anechoic chamber

7a. (For Translations) Title in Foreign Language

7b. (For Conference Papers) Title, Place and Date of Conference

8. Author 1. Surname, Initials	9a. Author 2	9b. Authors 3, 4	10. Date	Pages	Refs.
Hendy D.J.			August 1989	35	14
11. Contract Number	12. Period	13. Project	14. Other Reference Nos.		

15. Distribution statement

(a) Controlled by –

(b) Special limitations (if any) –

If it is intended that a copy of this document shall be released overseas refer to RAE Leaflet No.3 to Supplement 6 of MOD Manual 4.

16. Descriptors (Keywords) (Descriptors marked * are selected from TEST)

17. Abstract

The aim of the work was to determine the working space and frequency range limits of an anechoic sound chamber for accurate measurements of source sound power and directivity.

This was achieved by following guidelines in British Standard 4196 and noting the decrease of measured sound pressure levels with increasing distance from the source.

Results indicated that the chamber tested in this work was suitable for measurements within 1.5 dB across a frequency range of 125 Hz to 20 kHz so long as microphones are placed sufficiently far from the source and chamber walls. The characteristics of certain source sound fields may lead to an increase in the lower limiting frequency however.

F5910/1